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Reengineering Undergraduate Teaching by Introducing Internet-based Learning Information Systems

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Abstract - This paper illustrates how internet-based learning information systems can be used to reengineer undergraduate teaching in the age of mass higher education. We describe current problems of undergraduate teaching by using an example of an introductory course in information technology at the Vienna University of Economics and Business Administration. We argue that an internet-based learning information system supports specialisation, quality assurance and knowledge management. This paper also shows how internet-based learning information systems in combination with a re-organised teaching process leads to a more effective organisation. Obstacles to reengineering undergraduate teaching resulting from the legal framework are examined.

I. INTRODUCTION

Throughout the last century the context in which universities have been operating has changed dramatically. At the beginning of the 20th century, when higher education was mostly a privilege of a minority, universities were managed by the bureaucracy of government. At the beginning of the 21st century, when one out of three of today's youth in OECD countries enter tertiary education during the course of their lives [1], universities in Continental Europe are more and more moving to a corporate form of organisation [2]. Various forces such as new government regulations and new technologies are driving this transformation process [3]. In these days, higher education organisations are being asked to solve problems of costs, quality, effectiveness and access [4].

This paper illustrates how universities in Austria have difficulties in coping with new challenges. We suggest reengineering undergraduate teaching to meet customer demands and increase effectiveness of academic departments and the university as a whole. Introducing internet-based learning information systems support this process. We also address the issue of how internet-based learning information systems can be used to shift tasks from faculty to lower priced personnel [5].

The paper is organised as follows: Part 2 describes current problems and the ineffectiveness of the way undergraduate teaching is organised at Austrian universities today. In part 3 internet-based learning information systems are presented as a potential solution for the problem by reengineering undergraduate teaching as a whole. The effects on university output are also illustrated here. In part 4 we examine if undergraduate teaching can be reengineered under the given legal framework in Austria.

II. PROBLEMS OF THE ORGANISATION OF UNDERGRADUATE TEACHING

The business process "undergraduate teaching" consists of various stages. Once a course instructor is in charge of teaching an undergraduate course, s/he creates a course strategy and defines a teaching goal. With the course strategy in mind the instructor generates content. Based on the content generated a syllabus is created. The syllabus works as a guideline for the distribution process of the content. During the distribution process the course instructor receives feedback that might lead to a re-design of course strategy, content and syllabus.

Thus, the workflow of teaching an undergraduate course consists of the following four stages [6] (Figure 1):

- creation of course strategy,
- generation of content,
- creation of syllabus, and finally
- distribution of content.

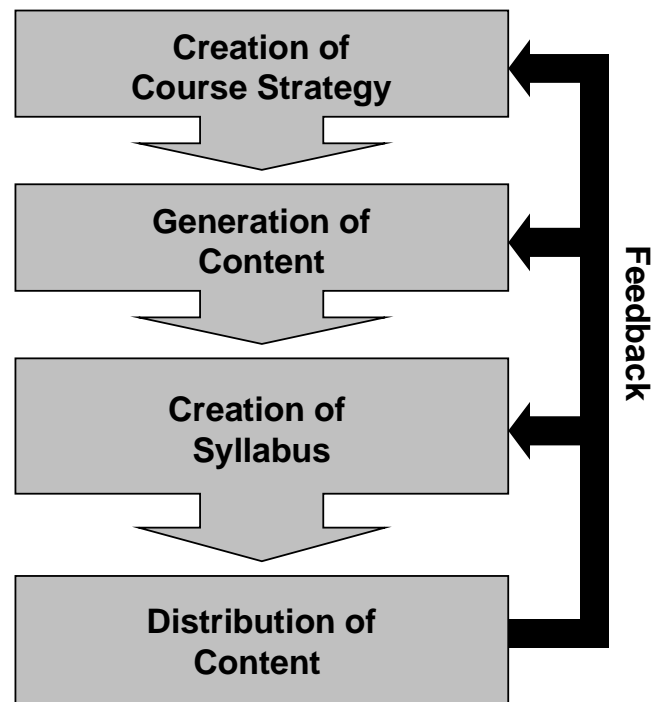


Fig. 1 The teaching process

In this process, challenges arise in many facets. They are described in the following sections. An example for developing a course taught at the Vienna University of Economics and Business Administration supports the illustration of these problems.

Part A reflects problems occurring in the strategy development process. Part B provides insight to the inefficiency and ineffectiveness of the content generation and syllabus creation process. Part C focuses on the distribution process.

A. Ineffectiveness in creating a course strategy

At the Vienna University of Economics and Business Administration about 27 introductory courses into information technology - so called 'Computer Workshops' - are offered to undergraduates every semester. In the winter semester of 1999/2000 these courses were taught by 22 different professors (12 assistant professors and 10 adjunct professors) of three different departments. [7]

The course strategy varies widely due to differences in interest, background and research of the different course instructors. The former chair of one department tried to establish a unified, customer-oriented syllabus for all computer workshops offered by his department [8]. This syllabus included word processing, spreadsheets and Internet. Although the syllabuses of the courses currently offered by this department are not identical any more, the contents cover the topics mentioned above to some extent. The other two departments use different, more advanced and specialised syllabus for their courses.

A survey carried out by the Department of Business Education at the Vienna University of Economics and Business Administration in 1997 showed the demand for introductory courses covering word processing, spreadsheets and Internet. Although 70 per cent of first year students stated that they had good or excellent word processing skills, only 10 per cent were capable of solving a corresponding exercise [9].

The demand for a course strategy which focuses on the introductory basics is also apparent in IT-introductory courses offered by university related institutions such as the alumni club and the placement centre. These two institutions together offer up to 12 courses per semester, which cover topics like word processing, spreadsheets and Internet [10, 11].

At the same time, courses of the department which concentrate on introductory basics are heavily demanded by the students. When registering for the computer workshop students have to indicate a preference for five different courses. Students are then assigned to one course automatically. This assignment process enables us to identify the demand for a particular course, although a bias resulting from the popularity of a particular course instructor and the attractiveness of the time schedule of a course must be considered. However, the aggregation of the registration

preferences indicates a clear preference for the courses which offer an introduction in word processing, spreadsheets and Internet. On average every course of this type is chosen by 56.5 students as their first preference. The other courses are only chosen by 17.1 students as their first preference. Although there is an increased customer demand for the course strategy developed by first-mentioned department, the other two departments do not see a need for adoption the course strategies of their courses accordingly.

Interestingly professors, teaching in the second part of the studies are complaining about missing skills of students needed for graduating. Because of the lack of unification of course strategies in the first part of the programs (undergraduate programs), professors teaching courses in the second part of the program (graduate program) cannot rely on the fact that students have a common knowledge of the subject.

The organisation of undergraduate teaching at many Austrian universities today, cannot ensure that universities are meeting market demands. Due to the freedom of teaching ('Freiheit der Lehre'), the quality of the skills of Austrian universities' graduates are not transparent. According to Gellert professors, protected by this Humboltian principle, mostly teach whatever they like, and hardly engage in personal tutoring of students [12].

In addition, employers have to provide additional education to their new employees to compensate for the shortcomings of higher education [13]. In the academic year of 1997/98 24 per cent of the graduates of the Vienna University of Economics and Business Administration went directly into a staff development program after they had been hired [14].

B. Inefficiencies in creating content and syllabus

Since the organisation of undergraduate courses at Austrian universities lacks co-operation and support of information technology every professor develops his/her course individually. There is no transparency for students, faculty members and university management what kind of knowledge students can obtain by taking a particular course. As a result students do not know whether their well-chosen courses match and if they can meet labour market demands with the skills obtained at these courses.

Newly hired assistant professors often have to start from scratch when it comes to course development. The achievements of course material by one assistant professor are not included in courses by the other assistant professors. Knowledge management does not take place. Feedback received - either in an informal, unstructured way when teaching the course or formal course evaluations -, is not considered when it comes to the (re-)design of the course. Assistant professors leaving the university quite often take their whole experiences with them and sometimes also their course material.

C. Problems with distribution of content

The principle of unity of research and teaching ("Einheit von Forschung und Lehre") provides another potential for ineffectiveness and inefficiencies. Since there are almost no synergies between research and undergraduate teaching some faculty members view teaching undergraduate courses as a burden. They would rather focus on their research for career purposes and increase their contribution to the research reputation of the university than to teach undergraduate courses. Since their research is not integrated in undergraduate courses, it does not necessarily contribute to the improvement of course quality. During the winter semester 1999/2000 7 out of the 27 computer workshops were taught by assistant professors, who had already finished or were currently working on their habilitation theses¹. The reason why these highly qualified researchers were teaching undergraduate courses is simple: due to the current government regulations assistant professors - no matter what qualification and reputation they have - are still the cheapest resource for course delivery.

III. REENGINEERING UNDERGRADUATE TEACHING WITH INTERNET-BASED LEARNING INFORMATION SYSTEMS

Internet-based learning information systems are information systems, which support the learning process and the process of creating course material. The following part illustrates how an internet-based learning information system can support the reengineering of undergraduate teaching.

A. Specifying an internet-based learning information system

In these days internet-based learning information systems often focus solely on distribution of content. An internet-based learning information system that allows reengineering of undergraduate teaching has to support all stages of the teaching process, especially content creation.

It has to allow the storage of learning objects in a structured way so that they can be accessed easily by multiple users. The information system enables users to select a learning object by its author, creation date, label or purpose. In addition, learning objects have to be classified so that instructors can easily choose the right learning object for his/her audience. Another classification identifies whether a learning object is an attention getter, content deliverer, questionnaire, or exercise. Editing tools have to support the assignment of learning objects to a course, i.e. the creation of a syllabus.

¹ After the completion of a habilitation thesis the faculty members are entitled to teach independently and freely in a specific discipline. It is also the prerequisite for an appointment as a full professor.

The courses stored in the information system can either be used in traditional education or can prepare the grounds for online education. When the content is distributed the learning information systems serves as a media for storing feedback. Annotations by course instructors and students provide an excellent input for transforming the internet-based learning information system to a knowledge media.

In addition to the features mentioned above the information system should also take advantage of push technology in order to keep course developers informed of recent developments in the course material database. Such functionality can easily be implemented by maintaining an e-mail-list of the content contributors. Whenever new content is published on the internet-based learning information system the whole community of contributors receives an e-mail pointing at the new learning object or comment.

B. Changing the organisation

Information technology is often used to reinforce existing organisational structures. A more challenging role for information technology is to create new organisational structures. [15]

Information technology can provide institutions with a competitive advantage; it can even create new business models that lead to the transformation of a whole market [16]. Internet-based learning information systems have the potential of causing a transformation process in the higher education industry [6, 17]. An internet-based learning information system with features as described above allows the reengineering of the teaching process as shown in figure 2.

This information system would support *specialisation*. The university can invite the best and most expensive experts to prepare the grounds for a high quality course. The input of those experts is stored in the learning information system. Teaching undergraduate courses is only conducted by instructors with an interest in the course. Their research agenda and their career level should correspond with the course. In addition, instructors experienced in coping with the instructional design challenges of undergraduate courses can be employed. A product manager can supervise the process. S/he has a background in higher education management and his/her professional background matches with the course content to ensure accuracy and relevancy.

The results of a survey conducted by the University of California in 1999 [18] showed that keeping up with the new technologies like the Internet or using computers for preparing materials cause more stress for professors than traditional factors like teaching loads and publishing.

An internet-based learning information system would support the creation and online publication of course material in order to relieve faculty members from the burden of coping with new technologies. The increased competition for students of the tertiary education sector would also be a

chance to up-value teaching in order to provide higher quality by relieving it from the burden mentioned above [19].

An information system with features described above would also contribute to the *quality assurance* of the teaching process. Although instructors can make minor changes to the course, these changes are stored in the information system. The product manager can then decide if all other instructors should also adopt these modifications.

A team of content providers consisting of experts, faculty members and course instructors supervised by the product manager should prepare the grounds for a new course. In addition whenever a major redesign of the course is required, the team should suggest a new course strategy and support the creation of new content. The feedback of students, experts, faculty members and instructors stored in the learning information system has to be included in the redesign process.

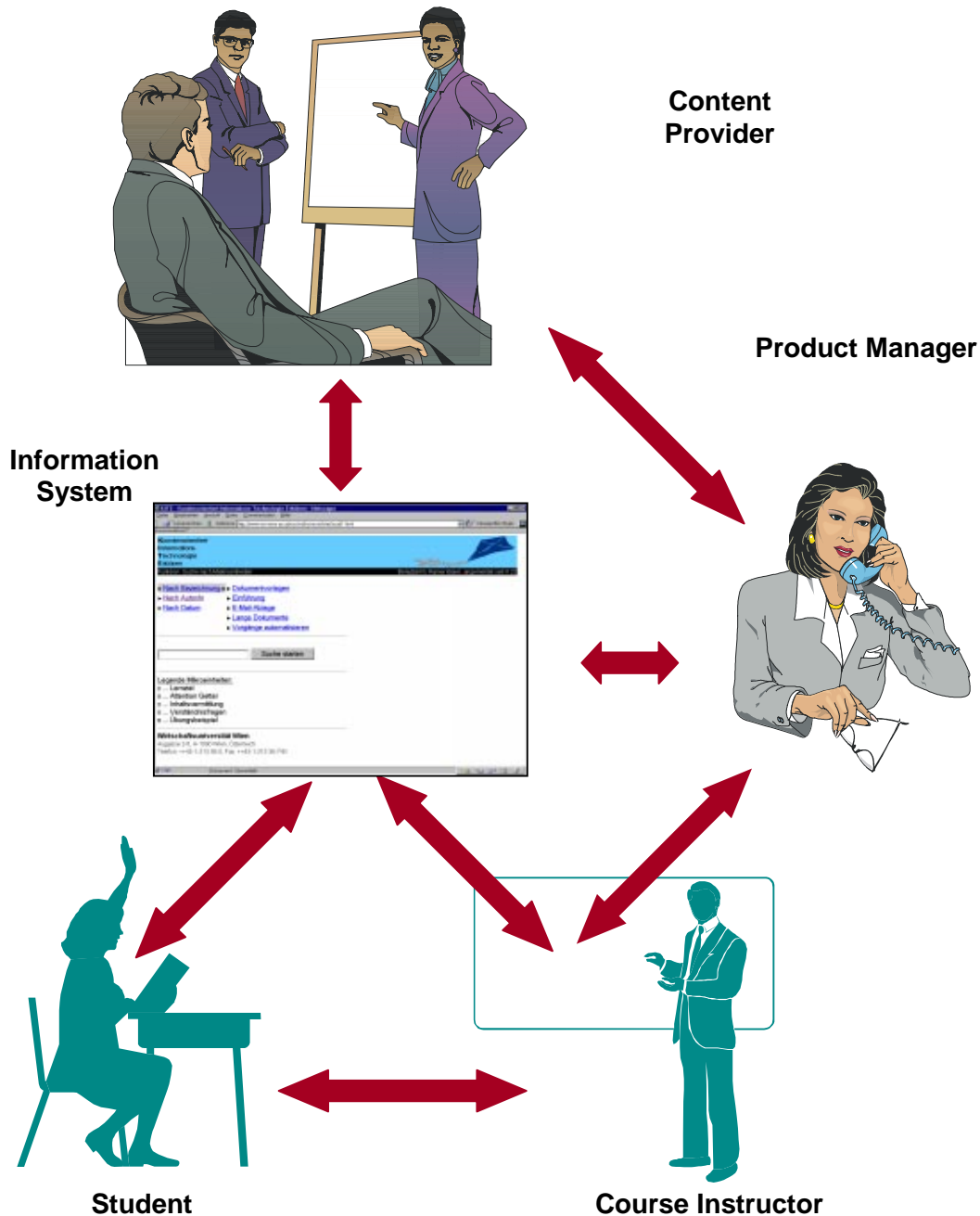


Fig. 2 Reengineered teaching process

Internet-based learning information systems enable universities to ensure a certain level of quality of their courses, because the content becomes transparent and formal and informal feedback is considered in the (re-)design. On this new level of quality, both, course instructors teaching on graduate level and recruiters can rely on. Thus, the whole university gains a competitive advantage. By doing so universities would even be able to outrange Fachhochschulen and further training facilities as far as quality assurance is concerned.

The labour market emphasises the need for better qualified personnel in times of rapid economic and technological changes. In this context it is essential that employers know about the skills of university graduates. By developing internet-based learning information systems employer's transparency is also given by providing the contents of the courses on the Internet [20].

The introduction of the European Computer Driving Licence² (ECDL) provides another argument for the increasing demand for content management in the case of undergraduate computer workshops. The ECDL should increase competence of employees and subsequently their job security by establishing a standardised certificate for the computer knowledge of end users. Due to several government initiatives, students became increasingly interested in obtaining this certificate. Content management via an internet-based learning information system can assure that university students will have the knowledge they need for passing the ECDL exams.

The third advantage of internet-based learning information systems is the support of *knowledge management*. All course material created within a department is stored in the information system in a structured way. Students, course instructors and experts reviewing the course material could use annotations [21, 22] to add experiences and feedback to the course material. In addition, faculty members can also add research experiences.

Since course modifications can be stored in the information system, it enables instructors to benefit from advancements. New instructors can rely on professionally developed and maintained course materials, which enables them to focus on instruction instead of worrying about the content. Additionally, knowledge of leaving instructors remains in the information system.

IV. LEGAL FRAMEWORK IN AUSTRIA

In the following part we examine if reengineering of undergraduate teaching can be carried out considering the given legal framework of Austrian universities.

The Austrian higher education system is characterised by the central ideas of Wilhelm von Humboldt of the late nineteenth century. The Humboldtian model follows a specific understanding of gaining empirical knowledge and

the attempt to utilise it directly for teaching purposes. This idea primarily aims on the discipline, but does not consider the needs of the students and the economy [12].

The Humboldtian principles are prescribed by Austrian University Law. In general, the organisation of teaching and research is determined by the Austrian University Organisation Act. It guarantees the academic freedom of teaching and learning and the unity of teaching and research [23]. In addition, seven out of twelve Austrian universities have written mission statements and all of them mention the guiding principle of research oriented teaching.

In Humboldt's time the university was only for a privileged, talented minority and considered as a place of broad education and research, emphasising personal development and training faculty [13]. Today the context of academic work has become dramatically different. Mass higher education, long study periods, high drop-out rates and a lack of curricular transparency suggest that the principles of Humboldt are not legitimate any more. In this context the question arises whether the unity of teaching and research is essential to mass higher education on an undergraduate level.

The introduction of an organisation of the teaching process as illustrated in part 3 would violate the principle of the unity of research and teaching, especially if teaching is only carried out by contractual instructors. Austrian universities would have to reconsider their mission statements if they would like to reengineer undergraduate teaching for better quality.

The University Organisation Act principle of the unity of research and teaching can be interpreted in a particular way. The law allows to set up a department, which is exclusively in charge of teaching or research. Thus, the principle of the unity of research and teaching focuses on the whole university, but not on a single organisational unit - like a department [23]. Therefore, the legal framework does not obstruct the reengineering of undergraduate teaching with internet-based learning information systems.

V. CONCLUDING REMARKS

In this paper, we sketch the idea of using internet-based learning information systems to reengineer undergraduate teaching. The introduction of internet-based learning information system can compensate the lack of quality assurance and knowledge management in undergraduate teaching at Austrian universities. The University Organisation Act in Austria allows such changes somehow, but does not necessarily encourage universities to improve undergraduate teaching.

Further research should be conducted to verify if undergraduate teaching is considered a burden by most faculty members. If this is found true we would like to examine if this lack of motivation results in a significant difference in teaching performance of high-qualified faculty members.

² see <http://www.ecdl.at/> (21/10/1999).

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